

primary missions is another means of upgrading a division's capability to counter attack helicopters. As outlined previously, several of the systems included in a heavy division's inventory, although not designed to attack helicopters, could do so. Some rather simple modifications to the division's tanks, fighting vehicles, and scout helicopters could enhance their effectiveness against enemy helicopters without significantly degrading their ability to perform their primary mission.

### Tanks

The ammunition used by main battle tanks is designed for maximum effectiveness against enemy tanks and fortified positions. As a rule, it must strike an object before detonating or causing any damage. Most munitions designed for use against aircraft include fuzes that cause the warhead to detonate if it comes close enough to sense the aircraft's presence.

Equipping tanks with some ammunition armed with proximity fuzes would improve their ability to destroy hovering helicopters at longer ranges without having to improve the accuracy of the gun itself. <sup>5/</sup> Because tank rounds designed for use against helicopters would not be very effective against armored vehicles, the majority of a tank's standard load would continue to be the type of ammunition currently used. Furthermore, because of the inherent inaccuracy of a tank's main gun, its ability to destroy helicopters, even with a special round, would probably not extend beyond three km; thus, tanks alone could not totally negate the projected standoff capability of Soviet helicopters.

### Bradley Fighting Vehicles and Improved TOW Vehicles

The TOW antitank missile on both the Bradley Fighting Vehicle (BFV) and older Improved TOW Vehicle (ITV) is potentially a very effective weapon against hovering helicopters. Because the TOW receives commands from a wire attached to its tail and connected to the launching vehicle, however, both its range and speed are limited by the amount of wire that can be stored within the missile and the rate at which it can be played out. Removing this limitation by converting the missile's guidance to one that relies upon either a laser beam or radio frequency command link could increase the missile's range to at least seven km and its speed to Mach 2.

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5. The Army is investigating a new tank round that would be effective against both helicopters and tanks. However, this round is still under development and is not likely to be available in large numbers in the next five years.





Equipped with such a missile, the BFV and ITV would be able to negate the standoff capability of any Soviet helicopters likely to be deployed during the next decade.

Of course, without a specialized sensor, each individual fighting vehicle's ability to detect aircraft might be limited. Nevertheless, replacing the current TOW missile entirely with a new longer-range, faster missile would provide each fighting vehicle with an impressive self-defense capability against attacking helicopters.

### Scout Helicopters

Each heavy division currently includes 44 scout helicopters whose missions are to assist the division's 36 attack helicopters by locating targets and to provide target acquisition and fire direction for the division's field artillery. The scouts attempt to operate close to or forward of the friendly forces closest to the front. Because of their position on the battlefield and elevation above the terrain, scout helicopters would be in a good position to see enemy helicopters when they attack. In fact, by hovering at an altitude of 20 meters, scout helicopters close to the front would have a 26 percent better chance to see a hovering helicopter six km away than would ground air defenses (see Figure 9).

Equipping scout helicopters with air-to-air missiles would enable them to attack enemy helicopters they encounter. Furthermore, because the Soviets are equipping their helicopters with air-to-air missiles, it would also provide U.S. helicopters with the ability to defend themselves. As was the case for ground-based air defense missiles, however, the missile added to the scouts should not be susceptible to countermeasures and should have a six to seven km range against hovering helicopters. These requirements would tend to argue against an infrared missile such as Stinger and for one relying on a laser beam or other means of guidance that is relatively resistant to countermeasures.

## AIR DEFENSE ALTERNATIVES

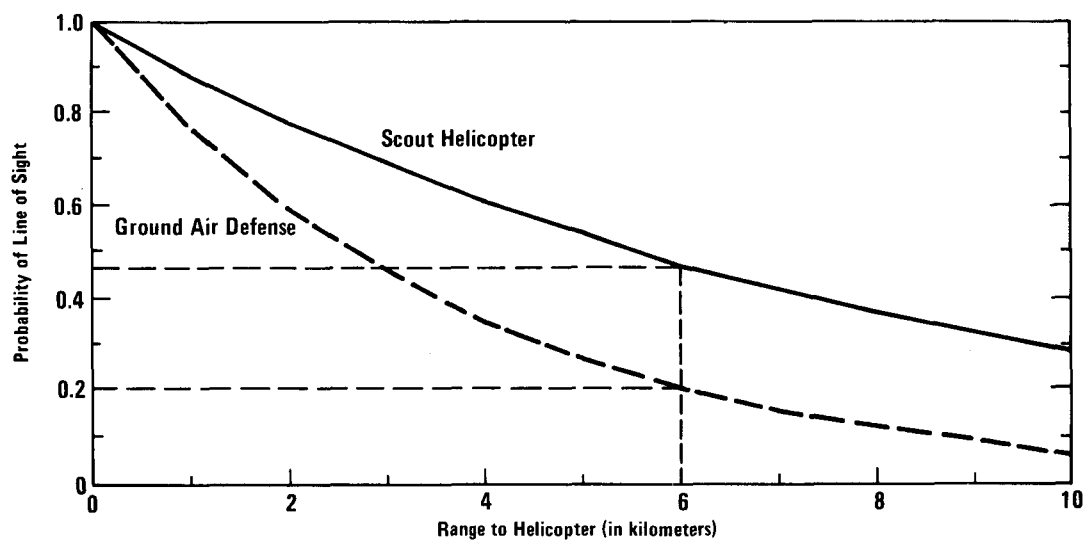
### Army Plans

The Army, recognizing the need to remedy the sparsity of air defenses against enemy standoff helicopters, has earmarked funds and begun a five-part program to improve its air defense, and in particular its antihelicopter

capability. (See the appendix for a detailed discussion of these plans.) One part of the Army's improvement plan for air defense would modify its scout helicopters so that they could launch air-to-air missiles. The costs of this program--which would provide only launchers for 720 scouts, and not the accompanying missiles--over five years would be \$163 million. The second part, the so-called "Air Defense System, Heavy" (ADS, H) program, is also designed to improve air defense for the Army's maneuver elements. The purpose of the ADS, H program is to field, as soon as possible, a system to perform the mission for which the DIVAD was intended--that is, successfully destroy hovering enemy helicopters at their operating ranges. The Army has allocated almost \$1.4 billion over the fiscal years 1987-1991 period for this program. The Army has not, however, decided what specific system to procure to fulfill the ADS, H role, or how many of these systems it wishes to buy. Thus, it is impossible to determine now whether the funds the Army has allocated for this program could provide enough capable systems to protect the forward maneuver elements.

Figure 9.

Probability of Unobstructed View of Hovering Helicopter at  
Altitude of 20 Meters



SOURCES: Congressional Budget Office from data contained in U.S. Army Material Systems Analysis Activity (AMSAA), *Air Defense Air-to-Ground Engagement (ADAGE) Simulation* (May 1978); and Department of the Army, TRADOC Studies and Analysis Agency (TRASANA) *Advanced Optical Study* (June 1982).

The total amount allocated for these two programs in the President's budget for fiscal year 1987 was \$1.5 billion (in fiscal year 1987 dollars) over the 1987-1991 period. This represents about 1.5 percent of the funds included in the President's budget for total Army procurement for the same five-year period (see Table 5).

### CBO Alternatives

CBO examined four alternative ways of combining the weapon system candidates to improve the Army's forward air defense capability. This list is by no means exhaustive. Rather, the alternatives were chosen to illuminate four decidedly different ways of improving, within five to ten years, the Army's ability to protect maneuver units from airborne attack.

The four alternatives and their main characteristics are summarized in Table 6. They run the gamut from retaining improved versions of today's

TABLE 5. FUNDS PROJECTED BY THE ARMY FOR AIR DEFENSE AND TOTAL ARMY PROCUREMENT (By fiscal year, in millions of fiscal year 1987 dollars of budget authority)

	1987	1988	1989	1990	1991	Total 1987-1991
Helicopter Air-to-Air Capability	29	42	48	45	0	163
Air Defense System, Heavy	<u>9</u>	<u>63</u>	<u>298</u>	<u>516</u>	<u>486</u>	<u>1,372</u>
Total, Air Defense	38	105	346	561	486	1,535
Total Army Procurement	18,600	20,400	20,300	20,600	21,500	101,400
Air Defense Funds as Percent of Total Army Procure- ment	0.2	0.5	1.7	2.7	2.3	1.5

SOURCE: Compiled by the Congressional Budget Office from Army data.  
NOTE: Numbers may not add to totals because of rounding.

systems (Alternative I) to placing the responsibility for air defense of the maneuver elements totally upon systems with other primary missions supplemented by small shoulder-fired systems similar to the current Stinger (Alternative IV). Alternatives II and III would take more orthodox approaches by replacing existing dedicated systems with new ones. Alternative II would replace the current Vulcan systems with three times as many chassis-mounted simple missile systems (CMMSs) or hybrid systems. Alternative III would replace Vulcan with a new, sophisticated, more capable missile system. All four alternatives would equip the Army's scout helicopters with air-to-air missiles capable of destroying enemy helicopters at long range since this appears to be a desirable addition under all approaches. The following sections provide a detailed discussion of the benefits of each alternative, in terms of increased battalion-level helicopter engagements, and the associated costs. 6/

#### Alternative I--Improve the Capability of Current Systems

The main shortcoming of the air defense systems currently included in the Army's heavy divisions is their limited range against hovering helicopters. As was pointed out earlier in the chapter, none of the weapons likely to be included today in a battalion task force has the ability to engage enemy helicopters attacking U.S. tank formations from ranges greater than three km. Although some of the range limitations are inherent to the weapon systems themselves (for example, Vulcan) and cannot be easily remedied, some improvement to the battalion's overall capability is possible at modest cost.

Description. Several modifications for Vulcan have been proposed by the Army in its Product Improved Vulcan Air Defense System (PIVADS) program. These include providing the system with an infrared sight (thereby enabling it to operate at night), upgrading Vulcan's fire control computer, and replacing the current ammunition with a new, improved 20mm round. Such modifications could extend the range of the system from its current 1.2km to as much as 1.75km. This, of course, would still be insufficient to counter enemy helicopters standing off from the armor formations at ranges greater than 0.75 km.

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6. The costs provided for each of the alternatives are presented merely for comparative purposes. Since most of the systems included in the alternatives are not currently being purchased by the U.S. government, it is impossible to determine their exact cost. The unit procurement costs used to estimate the total cost associated with each alternative were based on the cost of surrogate systems or contractor estimates.



Another simple modification to present systems--which the Army has proposed in its five-year plan--would be to equip the division's scout helicopters with air-to-air (AA) missiles. The required range of such missiles would be about six to seven km against hovering helicopters, which would exceed Stinger's maximum range. The Army would, therefore, need to acquire a new missile for this role. Small missiles employing some guidance other than infrared--such as the RBS-70 or Saber laser beam rider missiles--have been developed and could be adapted for use on helicopters. Long-range versions of the Saber or the RBS-70 could have a range of about five to seven km against hovering helicopters and could also be used against

TABLE 6. SUMMARY OF AIR DEFENSE ALTERNATIVES

Description	Systems Per Division a/		
	Area Rear	Area Forward	Air Defenses Shoulder-Fired
Alternative I-- Improve Current Systems	24 Chaparral	24 PIVADS <u>b/</u>	60 Stinger
Alternative II-- Deploy Many Simple Systems	18 Chaparral	72 CMMS <u>c/</u> 8 Alerting Radars	None
Alternative III-- Deploy Fewer New Sophisticated Systems	24 Chaparral	36 Missile Systems with Radar	None
Alternative IV-- Provide Tanks and Fighting Vehicles with Air Defense Capability	24 Chaparral	New Tank Round, New Missile for BFV and ITV <u>d/</u> 8 Alerting Radars	60 New Missile Teams

SOURCE: Congressional Budget Office.

- a. Each alternative also includes 44 scout helicopters with air-to-air missiles.
- b. PIVADS = Product Improved Vulcan Air Defense System.
- c. CMMS = Chassis-mounted simple missile system.
- d. BFV = Bradley Fighting Vehicle; ITV = Improved TOW Vehicle.

fixed-wing aircraft; however, the feasibility of using a helicopter-mounted missile to engage fixed-wing aircraft is unknown.

This alternative would also retain 24 Chaparral units per division for rear area defense of supply and command posts and 60 Stinger teams for protection against fighter bomber attacks. This option could require about 150 more soldiers than the 626 personnel that the Army now plans for the air defense battalion included in each of the heavy divisions.

Capability. Alternative I would result in a modest increase in the battalion task force's total number of potential engagements of an enemy helicopter. When compared with the current capability versus helicopters with one to three km standoff ranges, implementing the alternative could add three to four potential engagements for a relative increase of 10 percent to 25 percent. Perhaps more important, at ranges beyond three and one-half km--where there is essentially no current capability at all--this alternative would provide the modest ability for three potential engagements (see Figures 10 and 11).

No established criterion exists to determine how many potential engagements are needed in order to have a reasonable level of confidence in the level of air defense provided by a battalion task force. The greater the number of potential engagements, however, the less chance an attacking helicopter has of destroying its target. Furthermore, the measure in this study examines only **potential** engagements. Some might not be realized because a number of air defense units might be busy engaging other targets; other opportunities would be missed because of an air defense unit's failure to detect an attacker in the cluttered and confusing battlefield. Thus, the potential for three engagements, while certainly better than nothing, is not reassuringly large.

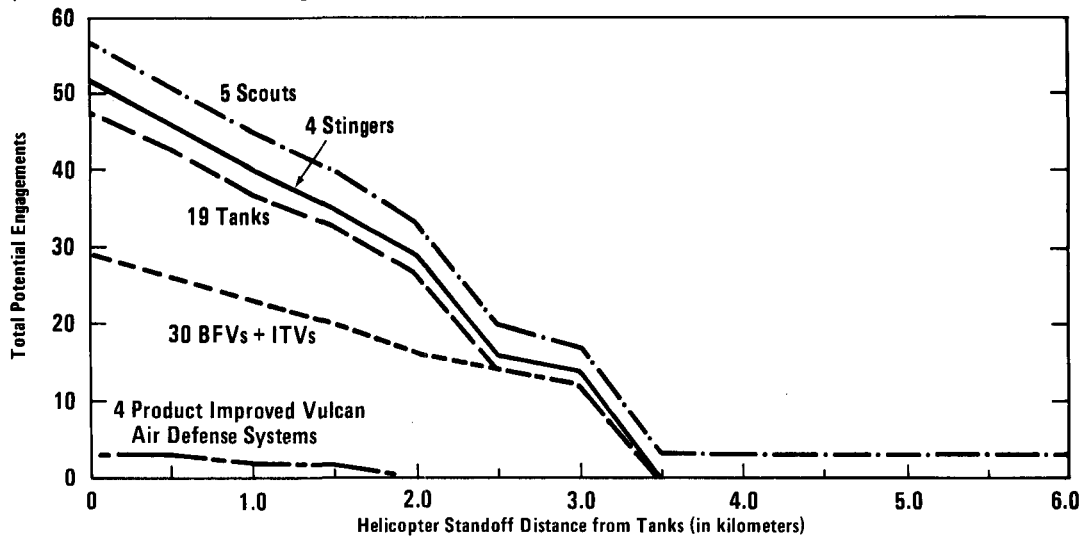
All the added capability for this alternative would result from providing air defense capability to the scout helicopters. Chaparral would be stationed too far back to engage attacking helicopters. Vulcan, Stinger, the fighting vehicles, and the tanks would still, as is the case today, have insufficient range to engage helicopters beyond three km.

While the increased capability under this option is modest, Army analyses have shown that, in the absence of any other air defense improvements, equipping U.S. scout helicopters with air-to-air missiles could significantly reduce U.S. losses to enemy helicopter attack. 7/ In

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7. U.S. Army TRADOC Studies and Analysis Agency (TRASANA), *Sgt York Alternatives Analysis* (October 1985).

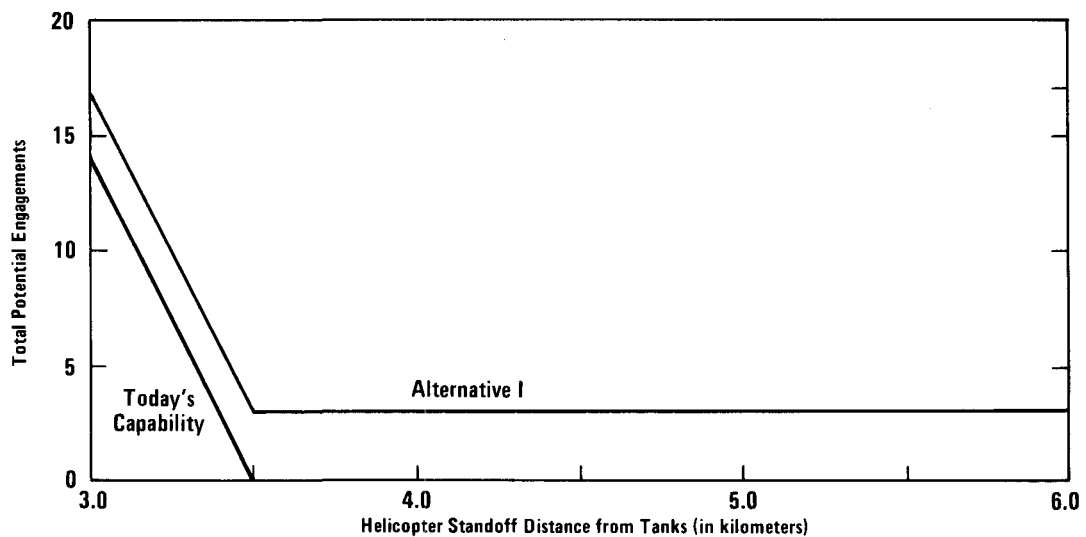
Figure 10.  
Potential Engagements of Hovering Helicopters Under Alternative I  
(Enhance Current Systems)



SOURCE: Congressional Budget Office.

NOTE: Assumes enemy helicopters hover at an altitude of 20 meters.

Figure 11.  
Comparison of Potential Engagements of Hovering Helicopters with  
Today's Systems and Those Included in Alternative I



SOURCE: Congressional Budget Office.

NOTE: Assumes enemy helicopters hover at an altitude of 20 meters.

addition, although not quantified in this analysis, the four Stinger missile teams included in the battalion task force should provide adequate air defense against attacking fighter bombers.

Cost. This option has the additional advantage of modest cost. Total investment cost would amount to \$430 million (in 1987 dollars of budget authority). Most of this cost would arise from equipping scout helicopters with air-to-air missiles, estimated to be about \$380 million. The remaining cost would be associated with the PIVADS program to improve Vulcan's performance. There could also be modest increases in operating costs. The alternative would require 150 additional personnel for each heavy division's air defense battalion, or 1,500 for the Army as a whole. As a result, annual operating costs could increase by \$26 million.

Some of these costs are already included in the Army's budget. For example, the Army plans to modify its scout helicopters as proposed in this option (see Table 5). Furthermore, the cost to improve Vulcan is less than that currently programmed for the Army's ADS, H program. As a result, adoption of this alternative could result in a net savings of \$1.1 billion in the Army's planned air defense spending over the next five years (see Table 7). (All dollars amounts are in 1987 dollars of budget authority.)

Drawbacks. Despite its modest cost, this option has two key drawbacks. Under this option, the only system capable of engaging attacking helicopters standing off at ranges over three km would be the scout helicopters whose primary mission is **not** air defense. It may make sense to give the scouts some air defense capability, as the Army is planning to do, because they are in a good position to see enemy helicopters. But an option that relied solely on scout helicopters for its long-range air defense would risk problems if the scouts were occupied in their primary mission of identifying targets for U.S. attack helicopters and field artillery. Second, two 20-year-old systems, Vulcan and Chaparral, would be retained. Both require relatively large crews (four and five, respectively) and Vulcan is of questionable utility because of its limited range.

#### Alternative II--Deploy Large Numbers of Simple Air Defense Systems

Given the age of its current short-range air defense systems, the Army will undoubtedly wish to replace them with modern systems, despite the cost. Any new systems fielded by the Army will be designed to have an effective range that is sufficient to destroy standoff helicopters. The second requirement for achieving an effective air defense--as discussed in the second chapter--calls for large numbers of dispersed systems. This

TABLE 7. COST OF ALTERNATIVE I COMPARED WITH  
CURRENT ARMY FIVE-YEAR PLAN  
(By fiscal year in millions of fiscal  
year 1987 dollars of budget authority)

	1987	1988	1989	1990	1991	Total 1987-1991	To Complete	Total Cost
Army's Plan <u>a/</u>	38	105	346	561	486	1,535	<u>b/</u>	<u>b/</u>
Alternative I	33	104	117	119	58	430	0	430
Change from Army plan	-5	-1	-229	-442	-428	-1,105	<u>b/</u>	<u>b/</u>

SOURCE: Congressional Budget Office.

NOTE: Numbers may not add to totals because of rounding.

- a. Includes the Army's program to add air-to-air missiles to 720 scout helicopters and the new Air Defense System, Heavy program--essentially a replacement for DIVAD.
- b. These numbers cannot be calculated since a specific Air Defense System, Heavy weapon has not yet been selected.

alternative seeks to fill this requirement at reasonable cost by equipping each division with a large number of relatively simple missile systems. These systems would then be able to complement the air defense contribution made by the scout helicopters equipped with AA missiles that are also included in this option.

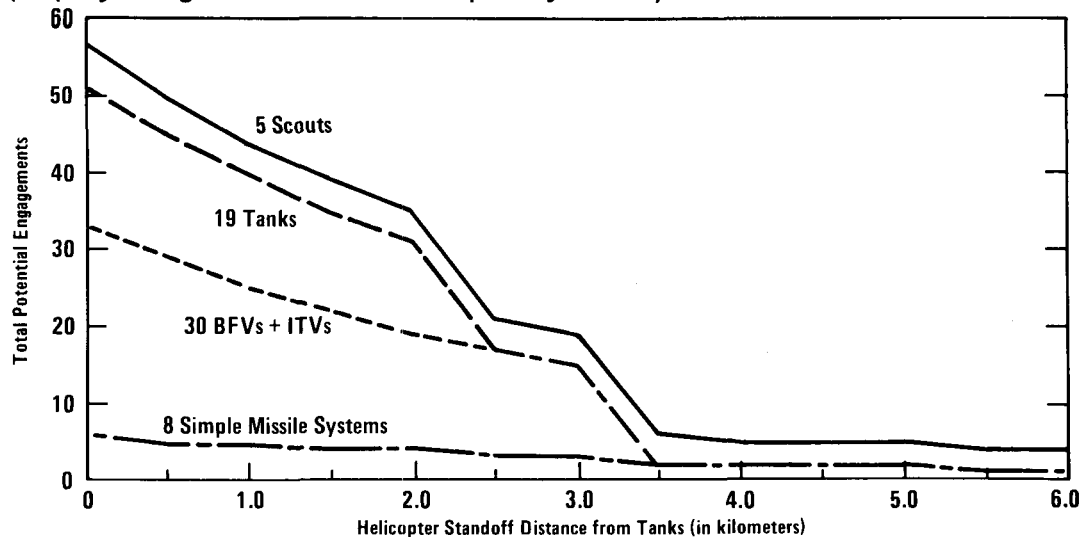
Description. This alternative would replace the 24 Vulcan anti-aircraft guns currently assigned to each armored and mechanized division with three times as many simple air defense systems to be used for air defense of the forward area. The simple systems envisioned would not use radars but would incorporate passive sensors (such as FLIRs) to acquire targets. New alerting radars, based on the Army's current TPQ-36 counter mortar radar, would be deployed, eight per division, to notify the air defenses of impending attack. The main armament of the system would be a missile--not Stinger or any other missile with infrared guidance--that would have at least a seven km range against hovering helicopters. It would rely on a fiber optic cable or laser beam for transmission of guidance signals to the missile and, thus, be relatively resistant to countermeasures. The system could also include a small caliber gun or hypervelocity rockets, if they could be incorporated into the system cheaply. Finally, the weapon would be mounted on a lightly armored chassis--such as the Bradley--with tracks, rather than wheels, to provide it with more mobility and some protection in the forward area where it will operate. These systems, referred to as "chassis-mounted missile systems" (CMMS) in this study, could be a hybrid of developed or existing systems. A combination of the RBS-70 or Saber missiles, the Bradley Fighting Vehicle chassis, and the 25mm GAU-12 Gatling gun currently on the Marine's Harrier aircraft is an example of a typical hybrid. The inclusion of 72 CMMSs within each division would enable eight air defense units to accompany each battalion task force.

This option, like the first alternative, would equip scout helicopters with air-to-air missiles and retain Chaparral in the division for protection of rear area command posts and other stationary assets, although it would provide just 18 per division rather than the 24 included in the other three options. Unlike the previous option, this alternative would include no shoulder-fired air defenses, such as Stinger. (See Table 6 for a summary of the characteristics of the options.)

Capability. The addition to each heavy division of 72 air defense weapons capable of engaging hovering helicopters out to ranges of seven km would greatly increase the engagement potential of a battalion task force (see Figure 12). The improvement over today's capability at ranges from one to three km could be two to three more potential engagements, an increase of



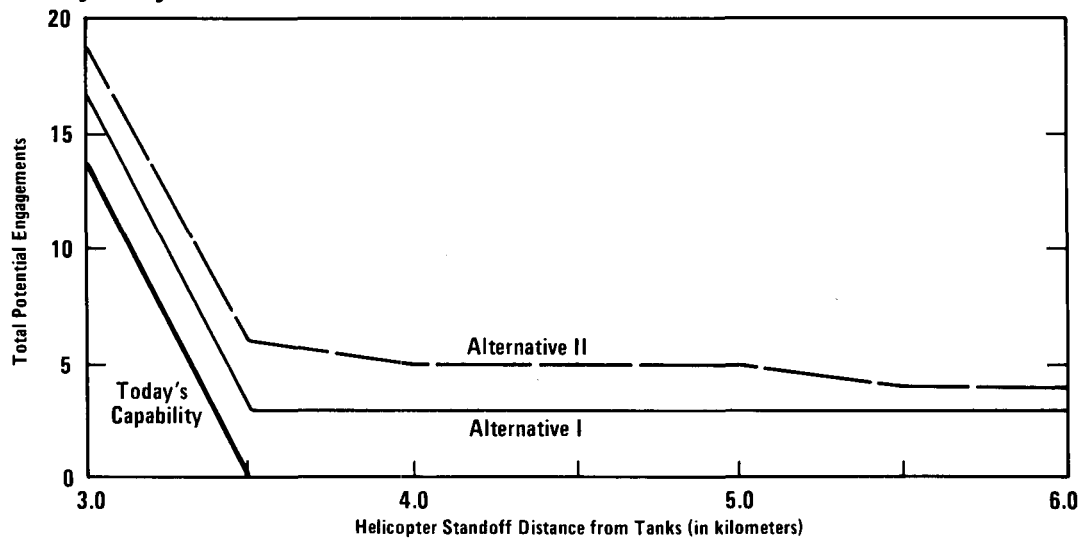
Figure 12.  
Potential Engagements of Hovering Helicopters Under Alternative II  
(Deploy Large Numbers of Simple Systems)



SOURCE: Congressional Budget Office.

NOTE: Assumes enemy helicopters hover at an altitude of 20 meters.

Figure 13.  
Comparison of Potential Engagements of Hovering Helicopters with  
Today's Systems and Those Included in Alternatives I and II



SOURCE: Congressional Budget Office.

NOTE: Assumes enemy helicopters hover at an altitude of 20 meters.

20 percent to 40 percent. More significantly, the combination of scout helicopters and CMMSs could yield as many as four or five engagements of helicopters attacking from ranges of four to six km. This is four or five more than is currently possible and one-third to one-half more engagements than in Alternative I (see Figure 13). Furthermore, two different systems--the CMMSs and scout helicopters--would be capable of engaging helicopters attacking from ranges greater than three km. This combination would greatly complicate the enemy helicopter's mission and attempts to survive. With respect to the threat from fixed-wing aircraft, the combination of Chaparral and another missile system should be able to provide adequate defense against fighter bombers.

Cost. The total investment cost to implement this alternative could be \$3.2 billion, with \$2.2 billion required during the period from 1987 through 1991, and \$1 billion more in the years thereafter. The largest portion of the investment funds would be required to procure sufficient numbers of chassis-mounted missile fire units and missiles (\$2.5 billion). Some additional cost (\$0.7 billion) would be associated with providing scout helicopters with air-to-air missiles and each division with eight new alerting radars. Since it is unlikely that the large number of systems needed to implement this alternative could be produced by 1991, the program to acquire new CMMS systems probably would not be completed until the mid 1990s. Thus, the accompanying costs would be spread out over this longer period (see Table 8).

The costs for this alternative would exceed by \$836 million the funds allocated by the Army over the next five years for those programs most directly related to forward area air defense (see Table 8). This would represent a 41 percent increase in the level of the Army's effort for forward area air defense, but only about a 0.8 percent increase in the Army's total procurement budget for the fiscal year 1987-1991 period. Additional funds totaling almost \$1 billion would be required after fiscal year 1991; the Army has not yet identified funds for forward area air defense beyond 1991. (All dollar amounts are in 1987 dollars of budget authority.)

Operation costs should not change significantly under this option. Elimination of 60 shoulder-fired (Stinger) air defense teams from each division would provide the additional personnel required for the 72 CMMSs without increasing the size of the division's air defense battalion. Indeed, a savings of about 90 personnel per division, or 900 people Army-wide, could be realized, for a small yearly savings of \$15 million.

Drawbacks. The air defense capability provided by this option would be an improvement over that currently available in the forward area of the Army's

TABLE 8. COST OF ALTERNATIVES I AND II COMPARED WITH  
CURRENT ARMY FIVE-YEAR PLAN  
(By fiscal year, in millions of fiscal  
year 1987 dollars of budget authority)

	1987	1988	1989	1990	1991	Total 1987-1991	To Complete	Total Cost
Army's Plan <u>a/</u>	38	105	346	561	486	1,535	<u>b/</u>	<u>b/</u>
Alternative I	33	104	117	119	58	430	0	430
Change from Army plan	-5	-1	-229	-442	-428	-1,105	<u>b/</u>	<u>b/</u>
Alternative II	65	241	417	779	680	2,171	985	3,156
Change from Army plan	+61	+136	+71	+216	+194	+836	<u>b/</u>	<u>b/</u>

SOURCE: Congressional Budget Office.

NOTE: Numbers may not add to totals because of rounding.

- a. Includes the Army's program to add air-to-air missiles to 720 scout helicopters and the new Air Defense System, Heavy program--essentially a replacement for DIVAD.
- b. These numbers cannot be calculated since a specific Air Defense System, Heavy weapon has not yet been selected.

divisions, especially at long ranges, and also over the capability provided by Alternative I. On the other hand, the costs associated with achieving the capability in this alternative would be four to five times those required for Alternative I.

Alternative III--Deploy Small Numbers of a New and Sophisticated Forward Air Defense System as a Replacement for Vulcan

As mentioned previously, the Army is currently relying on two 20-year-old systems to provide a large part of the air defense for its heavy divisions. This alternative would modernize the heavy division's air defenses by replacing the Vulcan anti-aircraft gun. The new system would have an effective range of seven to eight km against hovering helicopters, thus extending air defense coverage out six to seven km beyond the front line. In addition, each Vulcan would be replaced by 1.5 new systems, raising the total number of forward area air defense systems in each division from 24 to 36 (excluding Stinger teams).

This option would not provide the large numbers of systems that Chapter II argued are important for an effective air defense. It would, however, provide systems that are highly capable individually, and, thus, would be effective against helicopters at greater ranges. Of the four options in this study, this one most closely follows the approach of the Army's DIVAD program.

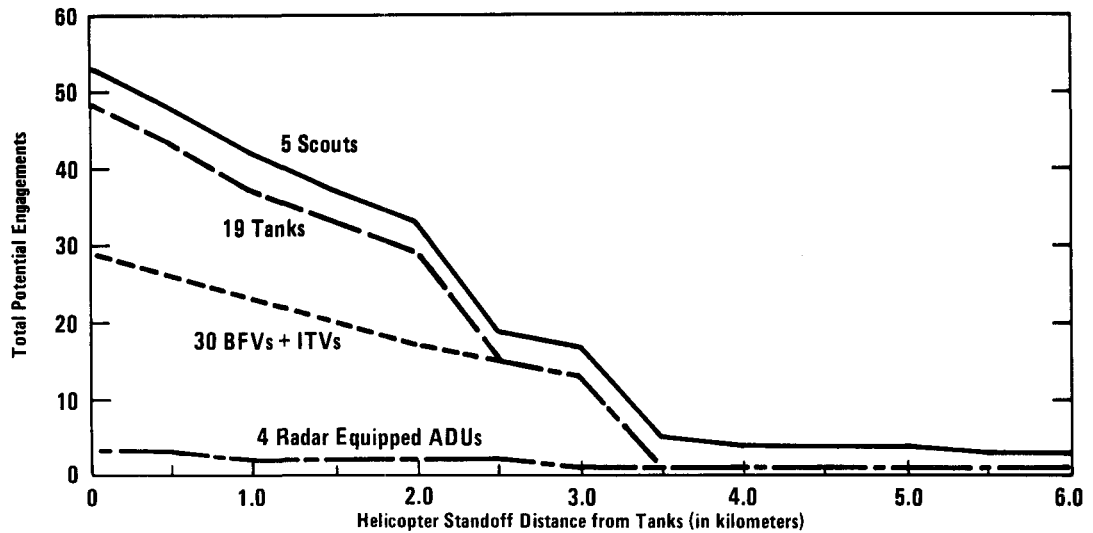
Description. Specifically, this alternative would replace the 24 Vulcans currently assigned to each heavy division with 36 forward area missile systems equipped with acquisition radars, mounted on lightly armored vehicles with tracks, and capable of long-range helicopter engagements (for example, systems like Rapier, Roland, or ADATS). Scout helicopters would, as in the other alternatives, carry air-to-air missiles. No shoulder-fired missile systems would be included in this alternative.

Capability. This alternative could add three to four total potential engagements to today's capability at ranges from four to six km. The added capability would come from the scout helicopters and radar-equipped forward missile systems.

When compared with the air defense capability provided in previous alternatives, however, this one would fall below Alternative II (see Figures 14 and 15). This shortcoming would occur because Alternative II includes twice as many ground-based air defenses as this alternative. This result does not automatically mean that this approach would be less effective than



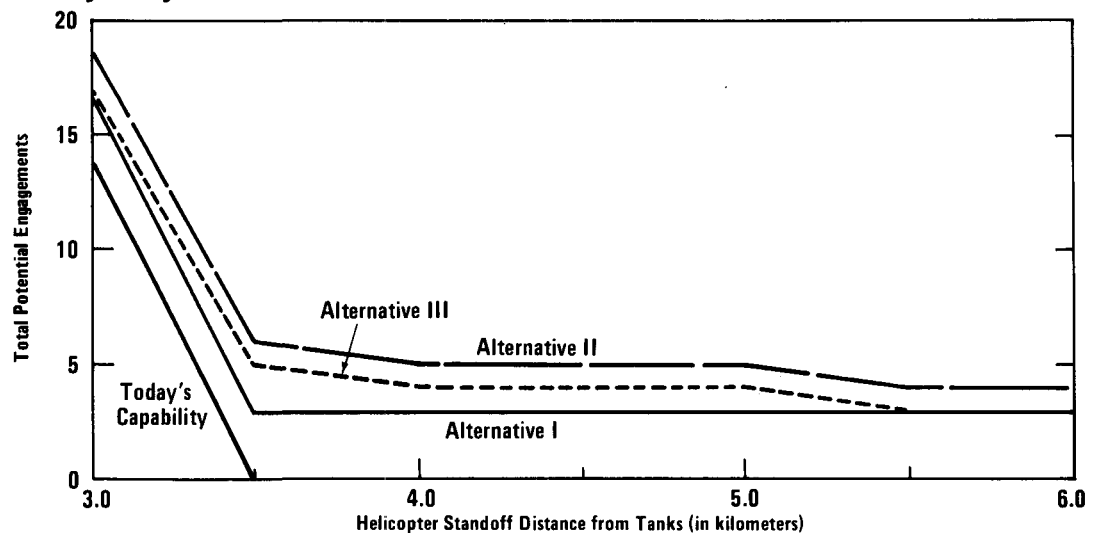
Figure 14.  
Potential Engagements of Hovering Helicopters Under Alternative III  
(Deploy Small Numbers of Sophisticated Systems)



SOURCE: Congressional Budget Office.

NOTE: Assumes enemy helicopters hover at an altitude of 20 meters.

Figure 15.  
Comparison of Potential Engagements of Hovering Helicopters with  
Today's Systems and Those Included in Alternatives I, II, and III



SOURCE: Congressional Budget Office.

NOTE: Assumes enemy helicopters hover at an altitude of 20 meters.

Alternative II with its many simple systems. None of those simple systems included a radar, which would enable automatic detection of targets at long ranges, over a wide sector, and in adverse weather. Coupled with the powerful missile provided by this approach, a radar could allow earlier engagement of attacking high-speed, fixed-wing aircraft than systems contained in other options. The Army has repeatedly stated that it needs this capability to meet the assumed threat. 8/

These advantages, however, might be of secondary importance. The radar's ability to operate in all types of weather might add little extra capability because enemy aircraft might not fly in bad weather or might be forced to use extremely disadvantageous tactics (such as flying higher or coming very close to their targets). Furthermore, the hilly terrain in Central Europe limits the ability of radar to detect low-altitude targets at long range. Finally, this option's increased capability against fixed-wing aircraft, while important, is less compelling because helicopters appear to pose the most demanding potential threat.

Cost. Moreover, the total investment cost required to implement this alternative could be more than \$4 billion, with \$3.2 billion needed during the next five years (see Table 9). The bulk of this amount would be spent to purchase the radar-equipped forward air defense units and associated missiles (\$3.9 billion), with \$0.4 billion more to provide air-to-air capability and missiles for the scout helicopters. No additional manpower would be required to implement this option; indeed, as in the last option, about 100 fewer people per division--or 1,000 throughout the Army--would be needed. Thus, an annual operating savings of \$17 million could be realized.

As with the previous alternative, implementation of and funding for this alternative would stretch beyond 1991 (see Table 9). Furthermore, funds above those allocated by the Army to forward area air defense would be required--\$1.7 billion during the fiscal years 1987-1991 period. This would represent more than a doubling of the funds currently earmarked for air defense and about a 1.7 percent increase to the Army's total procurement budget for 1987-1991. In addition, slightly over \$1 billion

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8. Statement of Lt. Gen. Donald R. Keith, USA, to the Senate Armed Services Committee, 97:1, March 5, 1981, pp. 1298, 1380, 1422; Statement of Maj. Gen. Louis G. Menetrey, USA, to the Senate Armed Services Committee, 97:2, March 3, 1982, p. 2125; Statement of Dr. Jay R. Sculley, accompanied by Lt. Gen. James H. Merryman, to the Senate Armed Services Committee, 98:1, March 10, 1983, pp. 1899, 1937, 1939, 1940; and Statement of Lt. Gen. Louis C. Wagner, Jr., USA, to House Armed Services Committee, 99:1, March 7, 1985, pp. 397, 398, 466.

TABLE 9. COST OF CBO ALTERNATIVES I, II, AND III COMPARED WITH CURRENT ARMY FIVE-YEAR PLAN (By fiscal year, in millions of fiscal year 1987 dollars of budget authority)

	1987	1988	1989	1990	1991	Total 1987-1991	To Complete	Total Cost
Army's Plan <u>a/</u>	38	105	346	561	486	1,535	<u>b/</u>	<u>b/</u>
Alternative I	33	104	117	119	58	430	0	430
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Alternative II	65	241	417	779	680	2,171	985	3,156
Change from Army plan	+61	+136	+71	+216	+194	+836	<u>b/</u>	<u>b/</u>
Alternative III	29	419	735	1,050	989	3,221	1,055	4,276
Change from Army plan	-9	+314	+389	+489	+503	+1,686	<u>b/</u>	<u>b/</u>

SOURCE: Congressional Budget Office.

NOTE: Numbers may not add to totals because of rounding.

- a. Includes the Army's program to add air-to-air missiles to 720 scout helicopters and the new Air Defense System, Heavy program--essentially a replacement for DIVAD.
- b. These numbers cannot be calculated since a specific Air Defense System, Heavy weapon has not yet been selected.

would be required after 1991 to complete the program. (All dollar figures are in 1987 dollars of budget authority.)

Drawbacks. The obvious drawback associated with this alternative is its low return for a relatively large investment cost. Although it would cost more, the total number of air defense systems fielded under this approach would actually be less than under Alternative II, and even Alternative II did not provide a reassuringly large number of engagements against each attacker.

#### Alternative IV--Improve the Air Defense Capability of Systems with Other Primary Missions

This alternative takes a different approach to improving the forward air defense. Rather than fielding any new vehicle-mounted system dedicated solely to air defense, this option would improve the air defense potential of the more than 700 fighting vehicles already within the heavy divisions. These weapons are primarily intended to attack ground targets. By equipping each weapon within a maneuver element with some capability for self-defense from air attack, however, this approach would create a force with the potential for a large number of engagements.

Description. To give the Bradley and Improved TOW Vehicles the ability to engage hovering helicopters out to six to seven km, a longer-range antitank missile would replace the TOW missile that is currently part of the fighting vehicles' armament. A missile designed primarily to defeat armor, but using a different means of guidance or command transmission, should also be able to destroy hovering helicopters at this longer range. Similarly, this alternative would provide the tanks within the division with ammunition designed to be effective against helicopters. As in Alternative II, eight new alerting radars would be included in each division to provide warning and cueing to the tanks and fighting vehicles. Twenty-four Chaparral units would be retained per division to provide air defense for the rear area of the forward portion of the division. A new man-portable missile, with a six to seven km range against hovering helicopters, would replace Stinger. Each of the 60 new missile teams per division would be provided with an infrared sensor for finding targets at night. Finally, as in the three other alternatives, the scout helicopters would be given an air-to-air missile capability.

Capability. This alternative could theoretically create as many as 16 potential engagements against hovering helicopters at three and one-half km and nine engagements at six km; no capability exists today at these ranges. Moreover, none of the other options in this study would provide such a large

number of potential engagements against attackers beyond three km. Thus, this approach should provide the greatest confidence that, even during a major air attack and amidst all the distractions and demands of the battlefield, most or all attackers could be engaged. Since few new systems would be added to the division's air defenses under this approach and some would actually be removed (that is, the Vulcan guns) very little improvement would be realized at ranges from one to three km. Today's capability at these ranges is already impressive, however.

The vast bulk of the improvement at long ranges would result from providing the Bradleys and ITVs with long-range missiles. Equipping the Army's tanks with an antihelicopter round might increase the tank's ability to engage helicopters somewhat, but it is unlikely that it would enable even the Army's latest tank, the M1, to engage hovering helicopters at ranges much greater than three km. The new man-portable, shoulder-fired missile, capable of engaging hovering helicopters out to six to seven km, would add only another one or two potential engagements to the battalion task force's total. Giving each Bradley and ITV a six to seven km antihelicopter ability, however, could add six to eleven engagements to a battalion task force's total potential engagements at ranges of three and one-half to six km (see Figure 16).

The potential for 9 to 16 engagements per attacker at three and one-half to six km assumes that all the tanks and fighting vehicles would devote their efforts to air defense. It is likely that, when under helicopter attack, a fighting vehicle's primary concern would be self-defense. Thus, this assumption might be reasonable. On the other hand, responsibilities within a task force could be divided so that a given percentage of fighting vehicles, such as 50 percent, would assume an active, though part-time, air defense role, with the remaining fighting vehicles concentrating solely on the ground battle, which is, after all, their primary mission.

Even with only 50 percent of a battalion's fighting vehicles participating in air defense, the potential helicopter engagements resulting from pursuing Alternative IV are at least 50 percent higher than those attributable to any of the three other alternatives, with six to ten engagements at ranges from three and one-half to six km, where today there are none (see Figure 17). Indeed, if as few as 25 percent of the fighting vehicles participate in air defense, as many engagements as those achieved with Alternative II would be possible. If all the fighting vehicles were provided with improved missiles and took advantage of an antihelicopter opportunity when presented with one, the number of possible engagements would rise to 9 to 16 at ranges from three and one-half to six km.